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THE PHILIPPINE

JOURNAL OF SCIENCE

C. BOTANY

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THE MOSSES OF AMBOINA

By V. F. BROTHERUS
(*Helsingfors, Finland*)

Sometime before the late Doctor C. B. Robinson started on his botanical excursion to Amboina he requested me to take over the examination of the bryological material that he hoped to be able to collect there. I consented to his proposal in view of the fact that the bryological flora of Amboina was practically unknown, and further because I had learned, from previous collections sent to me from the Bureau of Science, that Doctor Robinson was a very able collector. The hope that rich bryological collections from Amboina might be secured has not fully been realized, as this young explorer was murdered by the natives before he had completed his work of exploration. Thanks to Mr. Merrill's kindness I have had an opportunity of examining the collection of mosses that he left, and have prepared the following report. I have included in the list those species secured in Amboina by earlier collectors, such as Zippel, Naumann, DeVriese, and Micholitz in order that the report may be more complete.[1]

FISSIDENTACEAE

FISSIDENS Hedwig

FISSIDENS ZIPPELIANUS Doz. & Molk.

AMBOINA, Batoe merah and town of Amboina, on earth and wet rocks at low altitudes, *Rel. Robins. 2284, 2285, 2287 p. p., 2304 p. p.*

FISSIDENS CRASSINERVIS Lac.

AMBOINA, Hotoe messen, *Rel. Robins. 2466*, on earth, altitude 400 meters.

[1] The statement made by me to the effect that the manuscript of this paper had been lost in transit [*This Journal* 11 (1916) *Bot.* 245, 252] was an error; the statement applies to another manuscript on Philippine mosses. [E. D. M.]

LEUCOBRYACEAE

LEUCOBRYUM Hampe

LEUCOBRYUM ADUNCUM Doz. & Molk.

AMBOINA, Hitoe messen, *Rel. Robins. 2268*, on dead wood, altitude 350 meters.

LEUCOBRYUM SANCTUM Hamp.

AMBOINA, Hitoe messen, *Rel. Robins. 2328*, on dead wood, altitude 250 meters.

LEUCOBRYUM SERICEUM Broth.

AMBOINA, Salahoetoe, *Rel. Robins. 2267*, on ground and about the bases of trees, altitude 150 meters.

LEUCOPHANES Bridel

LEUCOPHANES OCTOBLEPHARIOIDES Broth.

AMBOINA, *Zippel.*

LEUCOPHANES CANDIDUM (Hornsch.) Lindb.

AMBOINA, near the town of Amboina, *Rel. Robins. 2276*, terrestrial; *Zippel.*

OCTOBLEPHARUM Hedwig

OCTOBLEPHARUM ALBIDUM (Linn.) Hedw.

AMBOINA, Wakal and town of Amboina, *Rel. Robins. 2275, 2282*, on sago palms and on *Sonneratia* at sea level.

CALYMPERACEAE

SYRRHOPODON Schwaegrichen

SYRRHOPODON BORNEENSIS (Hamp.) Jaeg.

AMBOINA, Wakal, *Rel. Robins. 2270*, on *Sonneratia* along the seashore.

SYRRHOPODON ALBOVAGINATUS Schwaegr.

AMBOINA, Hitoe messen, *Rel. Robins. 2307, 2328 p. p.*, on dead wood, altitude 350 meters.

SYRRHOPODON CILIATUS (Hook.) Schwaegr.

AMBOINA, Roemah tiga and town of Amboina, *Rel. Robins. 2271, 2273, 2277, 2290*, on the trunks of sago palms and on trees at low altitudes.

SYRRHOPODON CROCEUS Mitt.

AMBOINA, Hitoe messen, *Rel. Robins. 2308 p. p.*, on trees, altitude 250 meters.

SYRRHOPODON MÜLLERI (Doz. & Molk.) Lac.

AMBOINA, Hitoe messen, *Rel. Robins. 2315, 2327*, on trees, altitude 350 meters.

SYRRHOPODON MANII C. Müll.

AMBOINA, Roemah tiga, *Rel. Robins. 2278,* on trees, altitude 3 meters.

SYRRHOPODON FASCICULATUS Hook. & Grev.

AMBOINA, Batoe gadjah, *Rel. Robins. 2312,* on trees, altitude 200 meters; *Zippel.*

CALYMPERES Swartz

CALYMPERES PUNGENS C. Müll.

AMBOINA, *Naumann.*

CALYMPERES SEMIMARGINATUM C. Müll.

AMBOINA, *Naumann.*

CALYMPERES PANDANI C. Müll.

AMBOINA, *Naumann.*

POTTIACEAE

BARBULA Hedwig

BARBULA COMOSA Doz. & Molk.

AMBOINA, *Zippel.*

BARBULA ORIENTALIS (Willd.) Broth.

AMBOINA, town of Amboina, *Rel. Robins. 2288, 2320,* on earth and rocks at low altitudes.

HYOPHILA Hampe

HYOPHILA COMMUTATA Broth.

AMBOINA, *Zippel.*

GYMNOSTOMIELLA Fleischer

GYMNOSTOMIELLA VERNICOSA (Hook.) Fleisch.

AMBOINA, *Micholitz.*

ORTHOTRICHACEAE

DESMOTHECA Lindberg

DESMOTHECA APICULATA (Doz. & Molk.) Lindb.

AMBOINA, *Zippel.*

MACROMITRIUM Bridel

MACROMITRIUM ANGUSTIFOLIUM Bryol. jav.

AMBOINA, Roemah tiga, *Rel. Robins. 2294, 2296,* on trees at low altitudes; *Zippel.*

BRACHYMENIUM Schwaegrichen

BRACHYMENIUM INDICUM (Doz. & Molk.) Bryol. jav.

AMBOINA, *Zippel.*

BRYUM (Dill.) Schimper

BRYUM CORONATUM Schwaegr.

AMBOINA, *Zippel.*

MYURIACEAE

MYURIUM Schimper

MYURIUM RUFESCENS (Reinw. & Hornsch.) Fleisch.

AMBOINA, *Zippel.*

ENDOTRICHELLA C. Müller

ENDOTRICHELLA ALARIS Broth. sp. nov.

Dioica; robustiuscula, lutescens, sericeo-nitens; *caules secundarii* usque ad 10 cm longi, flexuosi vel arcuato-adscendentes, dense foliosi, simplices; *folia* sicca erecto-patentia, humida patentia, conformia, mollia, pluries plicata, oblonga, sensim lanceolato-subulata, marginibus inferne anguste recurvis, integris, apice tantum minute et parce serrulatis, enervia, cellulis valde inter se porosis, anguste prosenchymaticis, basilaribus infimis brevioribus, aureis, alaribus numerosis, quadratis, fusco-aureis; *bracteae perichaetii* internae eretae, sensim lanceolato-subulatae, subintegrae, *seta* ca. 1.8 mm alta, lutescenti-rubra, laevis; *theca* erecta, breviter oblonga, fuscidula, laevis. Caetera ignota.

AMBOINA, Salahoetoe, *Rel. Robins. 2298*, epiphytica, alt. 700 m.

Species *E. eleganti* (Doz. & Molk.) Fleisch. habitu sat similis, sed foliorum structura longe diversa.

ENDOTRICHELLA ROBINSONII Broth. sp. nov.

Dioica; gracilescens, pallide lutescenti-viridis, nitidiuscula; *caulis primarius* brevis, fusco-tomentosus; *caules secundarii* numerosi, usque ad 6 cm longi, dense et complanate foliosi, simplices; *folia* sicca et humida erecto-patentia, stricta, elongate lanceolato-ligulata, breviter acuminata, acuta, profunde plicata, marginibus anguste et indistincte recurvis, apice minute serrulatis, enervia, cellulis anguste prosenchymaticis, basilaribus infimis abbreviatis, laxis, fusco-aureis, alaribus haud diversis; *bracteae perichaetii* internae erectae, minutae, abrupte apiculatae vel obtusae, apice pluries incisae; *seta* ca. 1.8 mm, lutescenti-rubra, laevis; *theca* erecta, minuta, oblonga, fusca, laevis. Caetera ignota.

AMBOINA, Hitoe messen, *Rel. Robins. 2309*, alt. 350 m.

Species E. compressae (Mitt.) Broth., mihi e descriptione tantum cognitae, valde affinis.

AËROBRYOPSIS Fleischer

AËROBRYOPSIS LONGISSIMA (Doz. & Molk.) Fleisch.

AMBOINA, Hitoe messen, *Rel. Robins. 2308*, altitude 250 meters.

AËROBRYUM Dozy and Molkenboer

AËROBRYUM SPECIOSUM Doz. & Molk.

AMBOINA, *Zippel.*

NECKEROPSIS Reichardt

NECKEROPSIS GRACILENTA (Bryol. jav.) Fleisch.

AMBOINA, Hitoe lama, *Rel. Robins. 2329*, on trees, altitude 150 meters.

HOMALIODENDRON Fleischer

HOMALIODENDRON SCALPELLIFOLIUM (Mitt.) Fleisch.

AMBOINA, *DeVriese.*

THAMNIUM Schimper

THAMNIUM ELLIPTICUM (Bryol. jav.) Kindb.

AMBOINA, Salahoetoe, *Rel. Robins. 2297*, on wet rocks, altitude 250 meters.

HOOKERIACEAE

CALLICOSTELLA (C. Müll.) Mitten

CALLICOSTELLA BECCARIANA (Hamp.) Jaeg.

AMBOINA, Soja, *Rel. Robins. 2295*, on rocks, altitude 400 meters.

CHAETOMITRIUM Dozy and Molkenboer

CHAETOMITRIUM TORQUESCENS Bryol. jav.

AMBOINA, Hitoe messen, *Rel. Robins. 2293, 2300*, on living and dead branches, altitude about 150 meters.

HYPOPTERYGIACEAE

HYPOPTERYGIUM Bridel

HYPOPTERYGIUM VRIESII Bryol. jav.

AMBOINA, Halong, *Rel. Robins. 2332*, on rocks at low altitudes.

LESKEACEAE

PSEUDOLESKEOPSIS Brotherus

PSEUDOLESKEOPSIS ZIPPELLI (Doz. & Molk.) Broth.

AMBOINA, *Zippel.*

PELEKIUM Mitten

PELEKIUM VELATUM Mitt.

AMBOINA, Soja, *Rel. Robins. 2303*, on rocks, altitude 400 meters; *Naumann* (*P. fissicalyx* C. Müll.).

THUIDIUM Bryol. eur.

THUIDIUM BIFARIUM Bryol. jav.

AMBOINA, Halong, *Rel. Robins. 2306*, on rocks, altitude 30 meters.

THUIDIUM GLAUCINOIDES Broth.

AMBOINA, Salahoetoe, *Rel. Robins. 2313*, on rocks, altitude 250 meters.

THUIDIUM CYMBIFOLIUM (Doz. & Molk.) Bryol. jav.

AMBOINA, *Zippel.*

THUIDIUM PLUMULOSUM (Doz. & Molk.) Bryol. jav.

AMBOINA, Hitoe lama, *Rel. Robins. 2328*, on limestone, altitude 150 meters; *Webb.*

HYPNACEAE

MACROTHAMNIUM Fleischer

MACROTHAMNIUM MACROCARPUM (Reinw. & Hornsch.) Fleisch.

AMBOINA, *Zippel.*

ECTROPOTHECIUM Mitten

ECTROPOTHECIUM VERRUCOSUM (Hamp.) Jaeg.

AMBOINA, town of Amboina, *Rel. Robins. 2321, 2336,* on sandstone and limestone at low altitudes.

ECTROPOTHECIUM ZOLLINGERI (C. Müll.) Jaeg.

AMBOINA, *Zippel;* Hitoe lama, *Rel. Robins. 2335,* on rocks, altitude 75 meters.

ECTROPOTHECIUM MANII Broth.

AMBOINA, Roemah tiga, *Rel. Robins. 2335,* on trees at low altitudes.

ECTROPOTHECIUM ICHNOTOCLADUM (C. Müll.) Jaeg.

AMBOINA, *Zippel.*

ECTROPOTHECIUM BUITENZORGII (Bel.) Jaeg.

AMBOINA, *Zippel.*

TRISMEGISTIA (C. Müll.) Brotherus

TRISMEGISTIA LANCIFOLIA (Harv.) Broth.

AMBOINA, Salahoetoe, *Rel. Robins. 2280,* terrestrial, altitude 150 meters.

ISOPTERYGIUM Mitten

ISOPTERYGIUM AQUIFOLIUM (Bryol. jav.) Jaeg.

AMBOINA, *DeVriese.*

VESICULARIA (C. Müll.) C. Müller

VESICULARIA MONTAGNEI (Bel.) Broth.

AMBOINA, *Zippel.*

VESICULARIA DUBYANA (C. Müll.) Broth.

AMBOINA, *Zippel;* town of Amboina, *Rel. Robins. 2304 p. p., 2318,* on earth at low altitudes.

VESICULARIA AMBOINENSIS Broth. sp. nov.

Autoica; robustiuscula, caespitosa, caespitibus densis, mollibus, sordide fuscescenti-viridibus, opacis; *caulis* elongatus, laxe foliosus, pinnatim ramosus, ramis patulis, usque ad 3 cm longis, valde complanatis, laxiuscule foliosis, simplicibus vel parce ramulosis, obtusis; *folia caulina* lateralia sicca contracta, humida patula, concaviuscula, ovata, subulato-acuminata, integra, enervia, cellulis elongate rhomboideo-hexagonis (ca. 5.1), teneris; *folia ramea* minora, brevius acuminata, laxius areolata. Caetera ignota.

AMBOINA, Halong, *Rel. Robins. 2301,* on rocks in swift water, mostly submerged, altitude 40 meters.

Species *V. scaturiginum* (Brid.) Broth. valde affinis.

TAXITHELIUM Spruce

TAXITHELIUM NEPALENSE (Schwaegr.) Broth.

AMBOINA, *Zippel;* town of Amboina, *Rel. Robins, 2272, 2311,* on bases of tree trunks at low altitudes.

TAXITHELIUM TURGIDELLUM (C. Müll.) Par.

AMBOINA, *Naumann.*

ECTROPOTHECIELLA Fleischer

ECTROPOTHECIELLA DISTICHOPHYLLA (Hamp.) Fleisch.

AMBOINA, Hitoe lama, *Rel. Robins. 2274,* on limestone, altitude 75 meters.

LEUCOMIACEAE

LEUCOMIUM Mitten

LEUCOMIUM ANEURODICTYON (C. Müll.) Jaeg.

AMBOINA, Salahoetoe, *Rel. Robins. 2334,* altitude 250 meters.

SEMATOPHYLLACEAE

TRICHOSTELEUM (Mitt.) Jaeger

TRICHOSTELEUM HAMATUM (Doz. & Molk.) Jaeg.

AMBOINA, Roemah tiga and Hitoe messen, *Rel. Robins. 2283, 2314, 2319,* on trees, sea level to 350 meters altitude.

SEMATOPHYLLUM (Mitt.) Jaeger

SEMATOPHYLLUM HYALINUM (Reinw.) Jaeg.

AMBOINA, Salahoetoe, *Rel. Robins. 2269, 2279,* on trees, altitude 700 to 800 meters.

SEMATOPHYLLUM WARBURGII Broth.

AMBOINA, Salahoetoe, *Rel. Robins. 2310,* on trees, altitude 850 meters.

RHACOPILACEAE

RHACOPILUM Palisot de Beauvois

RHACOPILUM AMBOINENSE Broth. sp. nov.

Dioicum; robustiusculum, caespitosum, caespitibus densis, depressis, viridibus, opacis; *caulis* longe prostratus, fusco-tomentosus, dense foliosus, pinnatim ramosus, ramis patulis, vix ultra 1 cm longis, cum foliis ca. 2.5 mm latis, curvatis, simplicibus, obtusis; *folia* sicca sursum curvata, humida planissima, breviter oblonga, obtusa, aristata, marginibus erectis, superne inaequaliter serrulatis, nervo tenui, in aristam brevem excedente, cellulis subrotundato-hexagonis, pellucidis, ca. 0.02 mm, mar-

ginem versus minoribus, basilaribus internis laxioribus, breviter oblongis, plus minusve alte secus nervum productis, omnibus laevissimis; *folia antica* multo minore, cordato-lanceolata, aristata, superne inaequaliter serrulata. Caetera ignota.

AMBOINA, Hitoe messen and Hitoe lama, *Rel. Robins. 2286, 2299*, on limestone, altitude 150 meters.

Species *Rh. spectabili* Reinw. & Hornsch. affinis, sed statura minore, foliis posticis oblongis, obtusis, minutius serrulatis, nervo tenuiore, brevius excedente dignoscenda.

POLYTRICHACEAE

POGONATUM Palisot de Beauvois

POGONATUM CIRRATUM (Sw.) Brid.

AMBOINA, *DeVriese.*

POGONATUM TEYSMANNIANUM (Doz. & Molk.) Bryol. jav.

AMBOINA, Soja, *Rel. Robins. 2316*, on banks, altitude 450 meters.

RHACELOPUS Dozy and Molkenboer

RHACELOPUS PILIFER Doz. & Molk.

AMBOINA, Hoetoemoeri road, *Rel. Robins. 2281*, on earth and stones, altitude 200 meters.

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A NEW SPECIES OF CALAMUS FROM AMBOINA

By O. BECCARI
(*Florence, Italy*)

CALAMUS ROBINSONIANUS Becc. sp. nov.

Scandens, gracilis, caudice vaginato 15 mm diam., vaginis (non flagelliferi?) spinis acicularibus armatis. Folia cirrifera, regulariter pinnata, parte petiolari brevi, complanata, aculeolata; segmentis numerosis, aequidistantibus concinnis, angustissime lanceolatis, majoribus 18 ad 22 cm longis, 10 ad 14 mm latis, apice subtilissime acuminatis, unicostulatis, utrinque in costa media setosis, nervis lateralibus tenuibus nudis; marginibus remotissime et appresse spinulosis vel fere laevibus. Spadices ♂ et ♀ similes, foliis multo breviores (±25 cm longi), furfure fusca adspersi, parte pedicellari propria destituti, complanati, paniculati, erecto-patuli; inflorescentiis partialibus bifarie divaricatis, disticis, simpliciter ramosis; spathis primariis brevibus, complanatis, anguste infundibuliformibus; spatha basilari subancipiti, pedicelliformi, 3 cm longa, in ore ciliata et exacte truncata; spathis superioribus sensim paullo minoribus, oblique truncatis, acutis vel acuminatis. Flores masculi curvuli, oblongi, obtusi, 5 mm longi. Spicae foemineae majores 4 cm longae, floribus disticis, utrinque 6 vel 7; spathellis brevibus breviter tubulosis in ore ampliatis; involucrophoris brevisime elevatis, subpedicelliformibus; involucris orbicularibus, discoideis. Fructus anguste elliptici, 1 cm longi, 5 mm lati, utrinque attenuati, conice rostratis; squamis per orthostichas 12 ordinatis, convexis leviter in medio sulcatis, stramineis, margine conspicue atropurpureo.

AMBOINA, Mount Salahoetoe (Salahutu), *Reliquiae Robinsonianae 1612* (♂ plant), *1613* (♀ plant), November 27, 1913, altitude 850 meters. Native name *rotang tuni*.

A very distinct species, referable to group XV of my monograph on account of its cirriferous leaves and non-flagelliferous leaf-sheaths; but in that group it has no affinities. It is particularly distinguishable by its spadices being considerably shorter than the leaves, and resembling those of a *Daemonorops*, but furnished with only short, infundibuliform, closely sheathing, primary spathes.

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A NEW SPECIES OF GUIOA FROM AMBOINA

By L. RADLKOFER
(*Munich, Germany*)

GUIOA Cavanilles

GUIOA MULTIPUNCTATA Radlk. sp. nov.

Arbor 5 m alta; rami teretes, glabri, cortice laevi rubro-fusco; folia abrupte pinnata; foliola alterna, sat approximata, oblongo-lanceolata, acuminata, basi inaequilatera (latere exteriore angustiore), petiolulis conspicuis fere ab apice sensim incrassatis rugosis suffulta, integerrima, chartacea, nervis procurvis arcuato-anastomosantibus, glabra nec nisi pilis microscopicis subulatis patentibus supra laxe adspersa, epapillosa, supra subfusca, subtus pallida, cellulis secretoriis crebris permagnis per staurenchyma, nec non sat magnis utriculiformibus per pneumatenchyma persita, inde dense grossiuscule pellucido-punctata, insuper insignia epidermide paginae superioris sparsim crystallophora, plurifoveolata, foveolis sat amplis; rhachis nuda, teretiuscula; paniculae axillares, parvae, petiolos vix duplo superantes, glabrae; discus sub fructu relictus annularis, aequalis, glaber; capsula inter minores, obcordato-triloba, breviter stipitata, styli reliquiis apiculata, lobis seminigeris ellipsoideis patentibus, 1 vel 2 interdum inanibus multo minoribus lateraliter compressis, glabra, aqua agitata spumam efficiens, endocarpio sclerenchymatico secus medianam interrupto laevi; semen ellipsoideum, totum arillo carnoso basi processu filiformi appendiculato obvolutum.

Rami 6 mm crassi. Folia petiolo 2 cm longo adjecto 18 ad 22 cm longa; foliola cum petiolulis 5 ad 7 mm longis 8.5 ad 14.5 cm longa, 2.5 ad 4 cm lata. Paniculae 3.5 cm longae. Capsula 8 mm alta, stipite vix 3 mm longo, 1.3 cm lata. Semen 6 mm longum, diametro 4 mm.

AMBOINA, Gelala, *Reliquiae Robinsonianae 1602*, September 19, 1913, altitude 125 meters, comm. ex Hb. Manil.

THE PHILIPPINE JOURNAL OF SCIENCE, C. BOTANY.
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THE RELATION BETWEEN LIGHT INTENSITY AND CARBON DIOXIDE ASSIMILATION

By WILLIAM H. BROWN and GEORGE W. HEISE
(From the College of Liberal Arts, University of the Philippines, and from the Bureau of Science, Manila, P. I.)

In the absence of complicating factors there is, with many photochemical reactions, a direct proportionality between light intensity and reaction velocity. This relationship was first postulated by Malaguti(13) and afterward experimentally substantiated by Draper.(7) It is expressed in the well-known law of Bunsen and Roscoe,(5) as follows:

$$E=kit,$$

where E is the photochemical effect, i the intensity factor, t the time factor, and k a constant.

Reactions free from complicating factors are by no means easy to find. Even with comparatively simple photochemical processes, in which all factors can be controlled with some degree of certainty, complications frequently arise which cause deviations from the Bunsen and Roscoe law. This is well illustrated by the difficulty encountered in securing reactions suitable for actinometric work. With long-continued reactions, high light intensities, or great changes in light intensity(22) the reaction velocity is often less than strict proportionality would require. This discrepancy between cause and effect has been determined experimentally by a number of workers, including Luther and Weigert,(12) and has been calculated by Byk.(6)

It has been determined that a simple relationship does not hold in the much-studied case of the exposure of the photographic plate.(22) For certain light intensities the photochemical effect produced S is proportional, not to the intensity I, but to the logarithm of the intensity, in accordance with the equation

$$S=k \log i.$$

For another intensity range the relationship is expressed by an even more complicated formula, namely:

$$S=\gamma \log (it+C).$$

There are progressively greater deviations from the Bunsen-Roscoe law with still higher light intensities. The augmentation of photographic effect proceeds more and more slowly until there is no further increase, when a certain limiting light intensity is reached.

The photosynthetic assimilation of carbon dioxide by plants is a complicated reaction affected by many factors; hence there is a priori no reason to expect that the relationship between assimilation and light intensity under natural conditions should be expressed as a simple, direct proportionality. The general statements [1] in the literature, however, give the impression that the amount of carbon dioxide assimilation in plants is directly proportional to the intensity of the incident light. The writers have recently had occasion to review the literature on photosynthesis, and believe it worth while to call attention to the fact that these statements by no means express the conclusions to be

[1] Pfeffer (17) says:

The photosynthetic activity increases proportionately to the intensity of the light, as has been repeatedly shown since the first experiments by Wolkoff. There is, however, a limit to the increase.

Further on, the foregoing statement is somewhat amended as follows:

No mathematically exact relation can be expected between the photosynthetic activity and the intensity of the light, for as the light increases other influences may be exerted, which directly or indirectly modify the assimilatory powers of the chloroplastids.

According to Jost (10):

As the light increases in intensity, CO_2-assimilation also increases. When the light is about as intense as ordinary sunlight, however, this relation is not maintained, and this for several reasons.

Barnes (1) writes:

From the point at which the effective energy of the light absorbed is just equal to disposing of the available CO_2, whether this is greater than natural or not, lessening the intensity of the light results in a proportional diminution of the amount of the product.

Blackman and Matthaei (2) make the following statement:

The general views expressed in this paper involve the assumption that *with all intensities of light the amount of assimilation is proportional to the intensity of the light* unless some secondary or limiting factor is at work.

Blackman and Smith (3) in their work on *Elodea* determined two points on a curve representing the relation between carbon dioxide assimilation and light intensity and then drew the curve as a straight line.

Jorgensen and Stiles (9) in an extensive review of the recent literature on carbon dioxide assimilation also hold that assimilation is directly proportional to light intensity.

derived from the available experimental data. If the photochemical process in carbon dioxide assimilation could be studied independently of all complicating reactions it might well show a direct proportionality between light intensity and reaction velocity, but the experimental evidence at hand does not prove that such a relation holds for photosynthesis as it takes place under natural conditions.

One of the most extensive investigations on the relation of carbon dioxide assimilation to light intensity is that of Reinke, who worked with *Elodea*.(18) In Table I we have summarized Reinke's Table VIII, using the average of all his values for assimilation with any given intensity of light. This is Reinke's longest and probably his most important experiment.

TABLE I.—*Summary of Reinke's Table VIII, showing the relation between light intensity and bubble emission.*

Light intensity.		First series. Number of bubbles.			Second series. Number of bubbles.		
Full sunlight=1.	$\frac{1}{16}$ sunlight=1.	In 15 seconds.	Increase per added unit of $\frac{1}{16}$ sunlight.	Average per unit of light.	In 15 seconds.	Increase per added unit of $\frac{1}{16}$ sunlight.	Average per unit of light.
$\frac{1}{16}$	1	5.5	5.5	5.5			
$\frac{2}{16}$	2	7.5	2.0	3.7			
$\frac{4}{16}$	4	11.0	1.7	2.7	8.7	2.2	2.2
$\frac{8}{16}$	8	18.5	1.9	2.3	15.0	1.6	1.9
$\frac{16}{16}$	16	27.0	1.1	1.7	23.2	1.0	1.4
$\frac{32}{16}$	32	35.0	0.5	1.1	29.7	0.4	0.9
$\frac{64}{16}$	64	39.0	0.1	0.6	30.2	0.02	0.5
$\frac{128}{16}$	128	38.2	0.0	0.3	31.5	0.02	0.2
$\frac{256}{16}$	256	39.0	0.0	0.1	31.5	0.0	0.1

Obviously the foregoing data show no simple direct proportionality between assimilation and light. Instead there is for each increase in light intensity a progressively smaller increase in the assimilation velocity. This progressive falling off in assimilation per unit of increase in light is very rapid, and it is, therefore, not surprising that with high light intensities increasing the intensity does not greatly augment the rate of assimilation.

In Table II we have calculated the increase in bubble emission per unit of light for Reinke's different tables. These results are in agreement with the more detailed calculations given in Table I for Reinke's Table VIII.

TABLE II.—*Augmentation in the rate of carbon dioxide assimilation per unit of light increase as shown by Reinke's tables.*

[Numbers represent increase in number of bubbles emitted.]

Light in units of $\frac{1}{16}$ sunlight.	Reinke's table number.								
	1	2	3	4	5	6	7	8	
								First series.	Second series.
1	4.0	9.0						5.5	
2	5.7	6.0	2.8			5.5		2.0	
4	5.4	4.0	5.1	0.9	1.0	8.6	0.7	1.7	2.2
8		3.2	4.4	1.6	1.9	2.9	0.5	1.9	1.6
16	1.5	0.5	0.9	1.2	1.2	2.5	0.2	1.1	1.0
32	0.0		0.0	0.8	0.6		0.1	0.5	0.4
64	0.0		0.0	0.2	0.2		0.0	0.1	0.0
128	0.0		0.0	0.0	0.0		0.0	0.0	0.0
256				0.0	0.0		0.0	0.0	0.0

It is to be noted that with very low light intensities Reinke frequently found that doubling the light intensity resulted in more than doubling the number of bubbles given off by *Elodea.* This result was probably due in part to the failure in the bubble-counting method to make correction for respiration. Other sources of error with low light intensities have been discussed by Reinke himself and by Pantanelli.(16) It would seem evident therefore that the results obtained with small ranges of low intensities cannot be regarded as expressing adequately the relation between carbon dioxide assimilation and light intensity and that, if a direct proportionality between light intensity and assimilation is found in such a case, this is due to the selection of a particular range of light intensities.

Reinke's interpretation of his results is as follows:

Die von Lichte abhängige Gasausscheidung (von Elodea) beginnt bei mittlerer Beleuchtungsstärke und steigert sich gleichsinnig mit der wachsenden Lichtintensität bis zu einem Maximum (Optimum), welches ungefähr dem directen Sonnenlicht entspricht, bald bei etwas geringerer, bald erst bei etwas höherer Intensität erreicht wird; jede weitere Vermehrung der Lichtintensität hat keine weitere Beschleunigung der Gasblasenausscheidung zur Folge.

* * * * * * *

Wenn Wolkoff im Allgemeinen eine Proportionalität zwischen Lichtintensität und Sauerstoffausscheidung beobachtet zu haben glaubt, so steht dies Ergebniss im guten Einklang mit den von mir über den Einfluss der mittleren Lichtintensitäten gemachten Beobachtungen; bei einer weiteren Verstärkung des Lichtes tritt dann eine Aenderung der für mittlere Intensitäten gültigen Curve ein, wobei der Effect des Lichtzuwachses sich verringert und endlich auf Null sinkt; bei niederen Lichintensitäten muss

eine angenäherte Proportionalität zwischen Lichtstärke und der ausgeschiedenen Sauerstoffmenge durch die Athmung in ähnlichem Sinne beseitigt werden.

One of the most widely quoted researches on photosynthesis is that of Pantanelli, (16) who also worked on *Elodea* with a bubble-counting method.

Pantanelli's results on this subject are perhaps best expressed in his figure *a*, obtained with a carbon dioxide concentration of 1 to 15 volume per cent. We have shown in Table III all the readings given by him in curve *a* for assimilation velocities with different light intensities up to full sunlight. In order to make Pantanelli's results comparable with those of other workers, we have reduced his readings from the number of seconds required for the evolution of ten bubbles to the number of bubbles evolved in ten seconds.

TABLE III.—*Carbon dioxide assimilation and light intensity (Pantanelli on Elodea).*

[Curve (*a*) 1–15 volume per cent CO_2.]

Series.	Light intensity (direct sunlight=1).		Initial value.			After ten minutes exposure.		
	Fraction.	Decimal.	Time required for 10 bubbles.	Number of bubbles in 10 seconds.	Increase in number of bubbles per unit of 0.01 direct sunlight.	Time required for 10 bubbles.	Number of bubbles in 10 seconds.	Increase in number of bubbles per unit of 0.01 direct sunlight.
			Seconds.			*Seconds.*		
I. Ascending	$\frac{1}{36}$	0.028	33.2	3.05	1.09	35.3	2.83	1.01
	$\frac{1}{25}$	0.040	21.0	4.76	1.40	22.0	4.55	1.41
	$\frac{1}{15}$	0.066	15.0	6.66	0.71	16.0	6.25	0.63
	$\frac{1}{9}$	0.111	12.3	8.13	0.33	13.3	7.60	0.30
	$\frac{1}{4}$	0.250	9.6?	10.4?	0.16		(?)	
	$\frac{1}{1}$	1.000	7.7	13.0	0.03	8.5	11.8	0.01
II. Descending	$\frac{1}{36}$	0.028	35.3	2.83	1.01	33.2	3.05	1.09
	$\frac{1}{25}$	0.040	26.0	3.85	0.83	24.7	4.05	0.82
	$\frac{1}{15}$	0.066	19.3	5.2	0.50	18.0	5.55	0.56
	$\frac{1}{9}$	0.111	15.1	6.6	0.31	13.9	7.2	0.37
	$\frac{1}{4}$	0.250	8.5	11.8	0.37			
	$\frac{1}{1}$	1.000	7.0?	14.3	0.03			

As in Reinke's work, (18) the first augmentation of the rate of bubble emission is in some cases proportionately greater than that of light. Again the results show not a direct proportionality between assimilation and light intensity, but a progressively smaller relative increase in assimilation with increasing illumination.

In fig. 1 we have shown this relation graphically by plotting on plain coördinate paper the results given in Table III for light intensities up to full sunlight. The initial values and the values after 10-minute exposure are plotted separately for both the ascending and descending series.

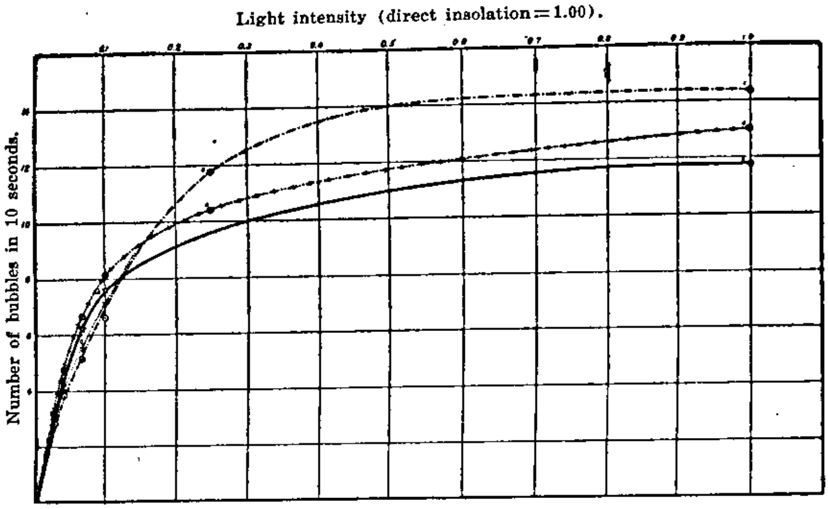

FIG. 1. Relation between light intensity and bubble emission in *Elodea*. Results obtained with carbon dioxide concentrations of 1 to 15 volume per cent. From Pantanelli, Table IV, curve *a*. Curve *a* is for the initial values in the ascending series; *b*, for values after 10-minute exposure in the ascending series; *c*, for initial values in the descending series; *d*, values after 10-minute exposure in the descending series.

It is clear that the general form of the curve would be the same, whether any one series or the average for all series were considered. There is no apparent reason for expressing the relationship as a straight line, as would be the case if the assimilation were directly proportional to light intensity.

Pantanelli himself does not clearly state his opinion concerning the validity of a direct proportionality, but in his discussion of the results of previous workers he apparently assumes that such a proportionality does exist.

In their analysis of Pantanelli's work Blackman and Smith,(3) by using a small horizontal scale and drawing their curve in an arbitrary manner, obtain a straight line for lower light intensities, and from this they conclude that

> From intensity 1/36 to 1/4 [sunlight] the assimilation increases in direct proportion with the increase of light and then a limit is reached.

The fallacy of this reasoning is apparent from the form of the curve in fig. 1. As there is no indication that a limit of assimila-

tion is reached at ¼ sunlight, there is no real justification for so abrupt a change in slope as is indicated in the curve given by Blackman and Smith.

These writers (3) take exception to the work of Pantanelli, because of the possible effect of temperature as a disturbing factor, as his work was carried out before Miss Matthaei had caused the great significance of this factor to be generally recognized. In a previous paper (4) we have shown that the temperature coefficient of carbon dioxide assimilation at the temperature at which Pantanelli performed his experiments (22° C. to 30° C.) is so small that the error, if any, introduced by neglecting to keep the temperature absolutely constant may well be disregarded.

In the same paper we analyzed the results of Matthaei (14) on cherry laurel, and found that the relation between light intensity and assimilation might be expressed as a regular curve, similar in form to those of Pantanelli (16) and Reinke. (18) Matthaei's results are shown in fig. 2. The agreement with the work previously discussed is particularly interesting, as Matthaei was experimenting with a land plant and made direct measurements of the carbon dioxide assimilated.

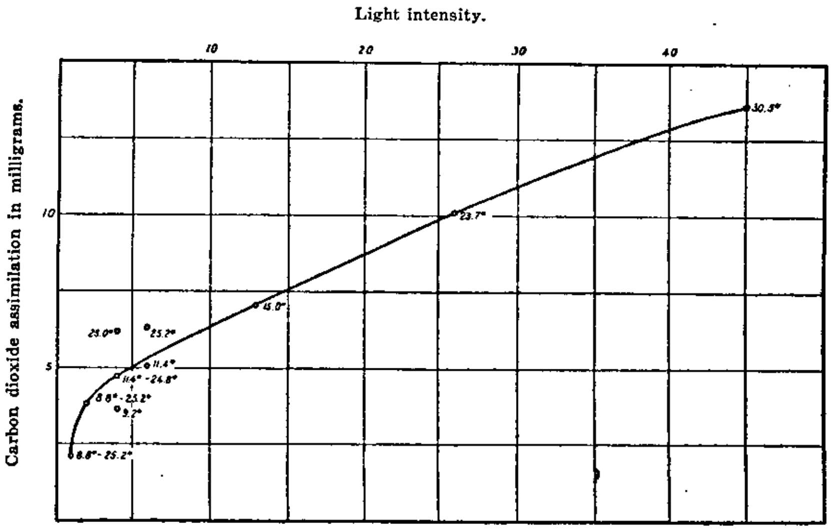

FIG. 2. Relation between carbon dioxide assimilation and light intensity. Data of Matthaei.

In reviewing the recent literature of carbon dioxide assimilation, Jorgensen and Stiles (9) lay considerable stress on the work of Blackman and Matthaei (2) as showing that there is a direct relation between carbon dioxide assimilation and various inten-

sities of natural illumination. As no measurements were made of the light intensity employed in this work, the results are qualitative and need not be considered here.

Edmond Rosé(19) has done considerable work on photosynthesis, but his interest was not primarily directed toward the study of the relationship between assimilation and light intensity, and his quantitative data are of no interest here.

The earlier work on this subject has been discussed critically by Reinke(18) and by Pantanelli,(16) who have shown conclusively that it failed to established the relation between assimilation and light. It requires, therefore little more than brief mention here.

Von Wolkoff(23) studied the effect of different light intensities on the rate at which gas bubbles were liberated from plants immersed in water containing carbon dioxide and found a very close proportionality between illumination and reaction velocity. He worked with feeble light intensities and only over a very small range. It is clear from the work of Reinke(18) and of Pantanelli(16) that the relation between bubble emission and light varies with different illumination intensities so that work over a small range cannot establish a general law.

The work of van Tieghem(21) has been quoted as showing that carbon dioxide assimilation is proportional to the incident light intensity. This author gave the results of a single experiment with a submerged water plant and concluded that the *acceleration* was proportional to the light intensity. His method of reaching this conclusion is not entirely clear.

The gasometric measurement of the assimilation of land plants with varying light by Müller(15) may be disregarded because of Pantanelli's apparently valid criticism of the experimental method employed. We have been unable to consult this work.

Reinke(18) has shown that the method of experimentation employed by Famintzin(8) is also open to objections. The results of the latter, however, do not show a proportionality between light intensity and assimilation.

The experimental results of Timiriazeff(20) on the influence of light on photosynthesis in *Potamogeton lucens* and certain land plants (species not stated) have been criticized by Pantanelli(16) because of the methods employed. Owing to faulty experimentation and the method of presentation of data in the original paper, this work has received scant attention. However, as the results show good general agreement with the works of Reinke,(18) Pantanelli,(16) and Matthaei,(14) and his interpretation is better than that of the other workers, we have summarized the results

in Table IV. In the absence of numerical data in the original paper, we have been obliged to interpolate values from the curve (p. 381) representing the mean of all his experiments. In this table the values for light intensity are given on the basis: direct insolation equals 1.0. The carbon dioxide decomposed is expressed in terms of a maximum assimilation equal to 100.

TABLE IV.—*Timiriazeff on photosynthesis.*

Light intensity (direct insolation=1).	Carbon dioxide absorbed.	Difference per 0.05 unit change in light.
0.05	20	20
0.10	38	18
0.15	56	18
0.20	67	11
0.25	76	9
0.30	84	8
0.35	89	5
0.40	93	4
0.45	95	2
0.50	97	2
0.55	98	1
0.60	99	1
0.7	100	0.5
0.7-1.0	100	0

Just as in Reinke's work (18) there is, per unit increase in light intensity, a progressively smaller augmentation of the rate of bubble emission. Timiriazeff's view of the relation between light and assimilation is expressed in the following statement:

On voit que la décomposition de l'acide carbonique augmente d'abord rapidement, ensuite de plus en plus lentement, atteint un maximum (correspondant à ½ environ de l'insolation directe), pour devenir définitivement stationnaire.

This seems to us to be the most accurate interpretation of the published data on the relation between light intensity and carbon dioxide assimilation that we have been able to find in the literature.

An exhaustive review is beyond the scope of the present article. The papers discussed are, however, those which are the most prominent in the literature and those on which the idea of a direct proportionality between carbon dioxide assimilation and light intensity are usually based.

Unfortunately, most of the work on the relation of carbon dioxide assimilation and light intensity has been done by the bubble-counting method. An exhaustive study by Kniep (11) has

shown that this method must be used with great caution and that consequently the published data are to a large extent unreliable. For example, Kniep found that the oxygen content of the bubbles varied from 22 to 45 per cent, depending upon the intensity of the incident light. His paper makes it very clear that the number of bubbles given off by a plant on illumination is not necessarily proportional to the assimilation.

SUMMARY

The published work on photosynthesis does not warrant the generally accepted conclusion that carbon dioxide assimilation in plants is proportional to the light intensity. Instead they indicate a progressively smaller augmentation of the rate of assimilation for each increase in light intensity. This decrease in the rate of augmentation continues until a point is reached at which further increase in light produces no measurable increase in assimilation.

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ILLUSTRATIONS

TEXT FIGURES

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NOTES ON THE FLORA OF KWANGTUNG PROVINCE, CHINA

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Through the interest of Doctor Walter T. Swingle, of the United States Department of Agriculture, Washington, D. C., I was enabled to spend the period from October 13 to November 9, 1916, in prosecuting field work in Kwangtung Province. Thanks to the courtesy of Mr. G. Weidman Groff, of the Canton Christian College, I was granted the facilities of that institution and made this the base of my field work. All collections were made on Honam Island, across the river from Canton, with the addition of one short trip, October 27 to 30, to Loh Fau Mountain (Lofaushan) in the country to the northeast of Canton. During the period spent in China, I collected about 600 numbers in all groups, and this collection presents a number of species previously unrecorded from China, or at least from Kwangtung Province, as well as some apparently undescribed forms. The present paper consists of the descriptions of these new species, and an enumeration of the additions to the Kwangtung flora, with a few references based on other collections, notably material secured by Mr. C. O. Levine of the Canton Christian College. In a few cases, where questions of nomenclature are involved, new combinations have been made.

Hance[2] makes the following statement regarding the Kwangtung flora:

> Six years ago the writer expressed the hope that he might shortly be able to give a complete list of all the plants which had been found in the province of Kwangtung. Further consideration, and especially the circumstance that almost every short excursion from Canton or other cities where foreigners reside leads to the discovery of three or four new plants, has convinced him that such an enumeration would, after all, be too imperfect to be worth compiling; whilst the opening of several new ports, and the annually increasing facilities for penetrating into the interior of the Empire, encourage the hope that we may soon acquire a far better and more comprehensive knowledge of one of the most interesting Floras which can occupy the attention of botanists.

[1] Professor of botany, University of the Philippines.
[2] Spicilegia florae sinensis I. *Journ. Bot.* 16 (1878) 6.

Since Hance's time an enormous amount of botanical material has been collected in all parts of China, Forbes and Hemsley[3] enumerating 8,271 species for the area covered by their work. For the flora of Kwangtung Province, Dunn and Tutcher[4] have listed and made keys for about 2,550 species of flowering plants and ferns, giving the distribution, within the area, time of flowering, and color of the flowers for each species. This publication forms an excellent working basis for the flora of Kwangtung. The regions indicated by these authors on their accompanying map as botanically explored comprises but a small percentage of the entire area of the province, and these areas are chiefly in the more accessible regions. They state in their summary of desiderata that it is desirable to explore not only the unknown areas, but also indicate the necessity of an investigation of the more accessible parts. The additions to the Kwangtung flora in the present paper are all from areas that have been fairly exhaustively explored, so it is evident that intensive field work in almost any part of Kwangtung Province may be expected to yield additions to the known flora, while an exploration of the vast botanically unexplored areas will certainly yield not only additions in the nature of already described species, but may be expected to yield a fair number of undescribed forms. The material collected by me adds several hundred localities to Dunn and Tutcher's list, but it has not been considered worth while to enumerate these here.

POLYPODIACEAE

HUMATA Cavanilles

HUMATA REPENS (Linn. f.) Diels in Engl. & Prantl. Nat. Pflanzenfam. 1[4] (1899) 209.

Loh Fau Mountain (Lofaushan), *Merrill 10335*, on cliffs in damp shaded ravines, altitude about 1,000 meters.

Widely distributed in tropical and subtropical Asia, extending to the Philippines and the Mascarene Islands.

ASPLENIUM Linnaeus

ASPLENIUM PRAMORSUM Sw. Prodr. (1788) 130.

Loh Fau Mountain (Lofaushan), *Merrill 10333*, on cliffs in shaded ravines, altitude about 1,000 meters.

Widely distributed in the tropical and subtropical parts of both hemispheres.

[3] An enumeration of all the plants known from China Proper, etc. *Journ. Linn. Soc. Bot.* **23** (1886–88) 1–521; **24** (1889–1902) 1–592; **36** (1903–05) XI + 1–686.

[4] Flora of Kwangtung and Hongkong (China). *Kew Bull. Add. Series* **10** (1912) 1–370.

DENNSTAEDTIA Bernhardi

DENNSTAEDTIA SCABRA (Wall.) Moore Index Filicum (1861) 307.

Loh Fau Mountain (Lofaushan), *Merrill 10246*, October 30, 1916, in damp ravines, altitude about 1,000 meters.

Widely distributed in tropical Asia, extending to the higher mountains of the Philippines; new to Kwangtung.

MONACHOSORUM Kunze

MONACHOSORUM SUBDIGITATUM (Blume) Kuhn Chaetopt. (1882) 345.

Loh Fau Mountain (Lofaushan), *Merrill 10234* (det. Copeland), October 28, 1916, in damp ravines, altitude 1,100 meters.

Widely distributed in tropical Asia and on the higher mountains of the Malay Archipelago and the Philippines; new to Kwangtung.

LEMNACEAE

WOLFFIA Horkel

WOLFFIA ARRHIZA Wimm. Fl. Schles. (1857) 140.

Honam Island, near Canton, *Merrill 10381*, locally abundant on stagnant water.

GRAMINEAE

ANDROPOGON Linnaeus

ANDROPOGON CHINENSE (Nees) comb. nov.

Homoeatherum chinense Nees in Hook. & Arn. Bot. Beechy's Voy. (1841) 239; Steud. Syn. (1854) 412.

Andropogon apricus Trin. var *chinensis* Hack. in DC. Monog. Phan. 6 (1889) 457.

Loh Fau Mountain (Lofaushan), *Merrill 10306*, on open grassy slopes, altitude about 600 meters.

The type of *Homoeatherum chinense* Nees was from Macao or its immediate vicinity, and the specimen cited above agrees closely with the description as repeated by Steudel. Hooker f.[1] considered that *Homoeatherum chinense* Nees, which Hackel included under *Andropogon apricus*, was the same as *Andropogon fastigiatus* Sw., in which disposition of it he was followed by Rendle, who, however, states that he had seen no specimen of the Chinese form. On account of its paired spikes I do not see how it can possibly be placed with Swartz's species, the only one in the subgenus *Diectomis;* and again, on account of prominently bisetose first glume of the sessile spikelet, I do not see how it can be placed under *Andropogon apricus* Trin., although I consider it to belong in the subgenus *Arthrolepis*. The pedicelled spikelets in our material are much smaller than in American specimens of *Andropogon fastigiatus* Sw. and differ from those of Swartz's species in many details.

ANDROPOGON SANGUINEUS (Retz.) comb. nov.

Rottboellia sanguinea Retz. Obs. 3 (1783) 25.

Thelepogon sanguineus Spreng. Syst. 1 (1825) 299.

Andropogon pseudograya Steud. Syn. 1 (1855) 365.

[1] Fl. Brit. Ind. 7 (1897) 170.

Loh Fau Mountain (Lofaushan), *Merrill 10191*, on open grassy slopes, altitude about 500 meters.

The oldest valid specific name for this species is here adopted. Rendle[6] enumerates this form from China as *Andropogon hirtiflorus* Kunth, following Hooker f.[7] in this identification. Hooker f. states that Dr. Stapf had identified the Indian form with the American and African ones. In any case *Rottboellia sanguinea* Retz. is the earliest name for the species.

DIGITARIA Heister

DIGITARIA VIOLASCENS Link Hort. Berol. 1 (1827) 229.

Honam Island, near Canton, *Merrill 10089*, on open sterile hillsides at low altitudes.

In this identification I follow Hackel, as the Chinese specimens conform in all particulars with Philippine material so named by him. It has perhaps been included in Chinese lists under *Digitaria longiflora* Pers.

PANICUM Linnaeus

PANICUM MYOSUROIDES R. Br. Prodr. (1810) 189.

Loh Fau Mountain (Lofaushan), *Merril 10270*, along the margins of a small pool in open grass lands near the summit, altitude about 1,250 meters.

India to tropical Africa, Malaya, and tropical Australia; not credited to China by Rendle in Forbes and Hemsley's Enumeration of Chinese plants.

PANICUM PALUDOSUM Roxb. Fl. Ind. 1 (1820) 310.

Honam Island, near Canton, *Merrill 9948*, about water holes in muddy places at about sea level.

This species has not hitherto been reported from China. Roxburgh's species has been confused by many authors with *Panicum proliferum* Lam., an American species, which Hitchcock has shown to be identical with the older *Panicum miliare* Lam. It is possible that *Panicum paludosum* Roxb. may prove to be identical with the American *Panicum dichotomiflorum* Michx.

PANICUM AURITUM Presl Rel. Haenk. 1 (1830) 305.

Honam Island, near Canton, *Merrill 9845*, about water holes, at about sea level.

India to Malaya and the Philippines, not previously reported from China.

ISACHNE R. Brown

ISACHNE CHINENSIS sp. nov.

Culmo erecto vel basi decumbente, circiter 50 cm alto, haud ramoso, glabro, infra circiter 2 mm crasso; nodis glabris vel minutissime puberulis; vaginis quam internodiis longioribus, striatis, margine prominente ciliatis; ligulis brevissimis, ciliatis; foliis subcoriaceis, patulis, lanceolatis, 5 ad 11 cm longis, 7 ad 12

[6] Journ. Linn. Soc. Bot. 36 (1904) 373.
[7] Fl. Brit. Ind. 7 (1897) 167.

mm latis, striatis, utrinque minutissime scaberulis, apice tenuiter acuminatis, basi latis, obtusis, abrupte cordatis vel subcordatis, margine cartalagineis, scaberulis; paniculis exsertis, 13 ad 20 cm longis, laxis, ramis paucis, elongatis, solitariis, viridis vel purpureis, glabris, tenuibus, paucifloris, inferioribus 10 ad 13 cm longis, patulis vel adscendentibus; spiculis ellipsoideis, purpureis, 2 mm longis, longe graciliterque pedicellatis, pedicellis glabris, 3 ad 9 mm longis; glumis vacuis glabris, late ellipticis vel orbiculari-ellipticis, rotundatis, 7- vel 9-nerviis; florentibus ellipsoideis, rotundatis, glabris vel apice minutissime setuloso-puberulis, 1.8 mm longis, nitidis.

Loh Fau Mountain (Lofaushan), *Merrill 10182*, October 28, 1916, on open slopes and along small streams, widely scattered, altitude 500 to 1,150 meters.

A species manifestly allied to *Isachne globosa* (Thunb.) O. Kuntze (*I. australis* R. Brown), which is very common in swampy places at low altitudes in Kwangtung Province, but readily distinguished by its much larger size, lax, very much larger panicles, long slender branches and pedicels, and other characters. In aspect it is quite different from *Isachne globosa*, although it is manifestly allied to it. The description of *Isachne altissima* Debeaux, a copy of which was kindly supplied to me by Mr. Tutcher, does not at all conform with the characters of the Loh Fau plant. Rendle suspects Debeaux's species to be a large form of *Isachne australis* R. Br.

ORYZA Linnaeus

ORYZA SATIVA Linn. Sp. Pl. (1753) 333.

Kwangtung Province, between Sheklung and Shansaiyen, *Merrill 10880*, October 30, 1916, the wild form.

To my knowledge the wild form of the rice plant has not previously been reported from China, although wild forms are definitely known from various parts of India. De Candolle[a] states: "The five species [varieties] are considered by the Chinese as indigenous in China, and it must be admitted that this is probably the case with rice, which is in general use, and has been so for a long time, in a country intersected by canals and rivers, and hence peculiarly favourable to aquatic plants." He further concludes that while the rice plant was a native of both India and of China, that the Indians cultivated the rice plant at a date later than the Chinese, thus involving the assumption that the species must have been a native of some part of China.

The wild form of the rice plant was discovered by me in the low country of the Canton delta, where it was observed at several localities in the plain between Sheklung and Shanseiyen, the latter place being a village near the foot of Loh Fau Mountain. Here it was locally abundant in tanks, water holes, and in stagnant streams approximately at sea level. This wild form is quite different in habit and appearance from the commonly cultivated forms of the rice plant in the Canton delta. The stems, while stout, are rather

[a] Origin of Cultivated Plants (1884) 385.

weak, more or less decumbent below, showing a tendency to branch at the nodes. The panicles are lax, with widely spreading branches. The spikelets are about 8 mm long, and fall very easily; while the very slender, stiff, straight awns attain a length of 7 cm. No awned rice was observed in cultivation in the vicinity of Canton, but long-awned varieties are in common cultivation in northern Luzon. It might be mentioned in passing that no wild form of *Oryza sativa* Linn. has ever been found in the Philippines, although at least two distinct indigenous species occur in the Archipelago. The discovery of this wild form of the rice plant in southern China confirms de Candolle's opinion that rice is a native plant in China. This form has undoubtedly yielded, by selection and improvement, the various forms of rice now so extensively cultivated in southern China, the selection and improvement following the lines of strictly erect habit, unbranched culms, elimination of the awns, and persistence of the spikelets at maturity.

CYPERACEAE

CAREX Linnaeus

CAREX BREVICULMIS R. Br. var. KINGIANA (Lév. & Van.) Kük. in Engl. Pflanzenreich 38 (1909) 470.

Loh Fau Mountain (Lofaushan), *Merrill 10181*, on banks along small streams, altitude 1,150 meters.

Widely distributed in various forms, India to Japan southward to Australia.

CAREX FILICINA Nees in Wight Contrib. (1834) 123.

Loh Fau Mountain (Lofaushan), *Merrill 10190, 10345*, in ravines and on open slopes, altitude 500 to 1,150 meters.

India to southern China and the Philippines, with varieties in Sumatra, Borneo, and Java.

JUNCELLUS Kunth

JUNCELLUS PYGMAEUS (Nees) C. B. Clarke in Hook. f. Fl. Brit. Ind. 6 (1893) 596.

Honam Island, *Levine 210*, December, 1916.

A greately dwarfed specimen of this widely distributed species; previously recorded from China only from Kiangsu Province.

RANUNCULACEAE

CLEMATIS Linnaeus

CLEMATIS CHINENSIS Osbeck Dagbok Ostind. Resa (1757) 205, 242; Merr. in Am. Journ. Bot. 3 (1916) 579, non Retz. (1791).

Honam Island, near Canton, *Merrill 9837*, November 3, 1916, in dry thickets at low altitudes.

Osbeck observed this species in the neighborhood of Canton and at Whampoa, so that the specimen cited above is practically a topotype. It agrees entirely with the very brief description and is the only species of *Clematis* observed by me in my exploration of the country about Canton. Unfortunately, the specimen presents no flowers so that I cannot be sure as to which of the species enumerated by Dunn and Tutcher from Kwantung it pertains, although I suspect it to be *Clematis benthamiana* Hemsl. In my

specimens the leaves are ternate, or the uppermost ones simple, not "pinnatisecta 5-nata" as described by Forbes in Journ. Bot. 22 (1884) 263 (*Clematis terniflora* Benth.). *Clematis chinensis* Osbeck is not the same as *C. meyeniana* Walp. as I formerly suspected.

POLYGONACEAE

POLYGONUM Linnaeus

POLYGONUM LONGIFLORUM Courchet in Lecomte Fl. Gén. Indo-Chine 5 (1910) 31, *fig. 4.*

Honam Island, *Levine 248*, January 20, 1917.

The specimen differs from Courchet's species in its somewhat broader leaves, but agrees in all essentials with the description, the figure, and a cotype of the species in the Herbarium of the Bureau of Science. A species otherwise known only from Tonkin.

ROSACEAE

STRANVAESIA Lindley

STRANVAESIA BENTHAMIANA (Hance) comb. nov.

Photinia benthamiana Hance in Ann. Sci. Nat. Bot. V 5 (1866) 213.
Stranvaesia calleryana Decne. in Nuov. Arch. Mus. Paris 10 (1874) 179; Hemsl. in Journ. Linn. Soc. Bot. 23 (1887) 264.

Canton and vicinity, *Merrill 10088*, November 4, 1916, in fruit; *Levine 443, 448*, March, 1917, in flower.

The type of Decaisne's species was from Canton, and the specimens cited above agree perfectly with his description, and morover conform with the description of *Photinia benthamiana* Hance, the type of which was also from Kwangtung Province. The fruits are those of *Stranvaesia*, and I have accordingly transferred Hance's specific name to this genus and reduced Decaisne's species as a synonym. In general appearance the species closely approximates *Photinia*, but in addition to its fruit characters is also distinguished from the Chinese species of *Photinia* by the branches and branchlets of its inflorescences being verticillately, not racemosely arranged.

LEGUMINOSAE

INDIGOFERA Linnaeus

INDIGOFERA ZOLLINGERIANA Miq. Fl. Ind. Bat. 1^1 (1855) 310.

Honam Island, near Canton, *Merrill 10050*, October 24, 1916, in thickets at the edge of a water hole; a small tree, about 4 meters high.

This characteristic species extends from southern China and Formosa through the Philippines and the Malay Archipelago to New Caledonia. Synonyms are *Indigofera teysmanni* Miq. and *I. benthamiana* Hance; see Prain and Baker in Journ. Bot. 40 (1902) 143 and Merrill in Philip. Journ. Sci. 5 (1910) Bot. 66.

FLEMINGIA Roxburgh

FLEMINGIA PHILIPPINENSIS Merr. & Rolfe in Philip. Journ. Sci. 3 (1908) Bot. 103.

Honam Island, near Canton, *Levine 188, 263*, December, 1916 and January, 1917.

The specimens agree in all particulars with the Philippine form which is known from a few localities in northern Luzon. It is by no means certain that *Flemingia philippinensis* Merr. & Rolfe is distinct from *Flemingia yunnanensis* Franch. Pl. Delavay. (1890) 185, as the material also agrees closely with Franchet's short and imperfect description; an examination of Franchet's type will be necessary to determine the relationship of the two.

MALVACEAE

SIDA Linnaeus

SIDA MYSORENSIS W. & A. Prodr. (1834) 59.

Honam Island, near Canton, *Merrill 9904*, in waste places near houses.

India to Java and the Philippines; not previously reported from China. This cannot, from Cavanilles's description, be *Sida glutinosa* Cav. to which it has been referred by some authors.

THEACEAE

EURYA Thunberg

EURYA SWINGLEI sp. nov.

Arbor parva, ramulis dense subferrugineo-villosis; foliis lanceolatis ad oblongo-lanceolatis, distichis, chartaceis vel subcoriaceis, 2 ad 3.5 cm longis, 7 ad 11 mm latis, brevissime petiolatis in siccitate flavido-viridis, supra glabris, subtus leviter pilosis, basi acutis ad rotundatis, saepius leviter inaequilateralibus, apice tenuiter acuminatis, acumine obtuso, margine obscure crenato-denticulatis vel integris; nervis lateralibus in pagina superiore obsoletis, subtus 4 ad 6, obscuris, arcuato-anastosantibus; petiolo circiter 0.5 mm longo, piloso; floribus ♀ axillaribus et e axillis defoliatis, solitariis vel binis, brevissime pedicellatis; sepalis ovatis, obtusis, haud 1 mm longis, villosis; petalis 5, oblongis, liberis, obtusis, circiter 4 mm longis et 1.5 mm latis; ovarium anguste ovoideum, dense pallide sericeo-villosum; stylis 3 vel 4, elongatis, glabris, recurvatis, 1.5 ad 2 mm longis ima in stylum elongatum cylindricum glabrum vel subglabrum 2 ad 3 mm longum connatis.

Loh Fau Mountain (Lofaushan), *Merrill 10233*, October 28, 1916, in damp shaded ravines, altitude about 1,000 meters.

A very characteristic species, conforming in many characters with *Eurya distichophylla* Hemsl., from which it is distinguished by its acuminate leaves which are pilose, not strigillose beneath, the veins obsolete on the upper surface, obscure beneath and not impressed, and its oblong, not oblong-obovate, free petals. Hemsley's description was based on a staminate specimen from Amoy. The type of the present species is a pistillate specimen, the pistillate flowers being characterized by their densely silky-villous ovaries and greatly elongated styles, which are united for the lower 2 to 3 mm. The species is dedicated to Doctor Walter T. Swingle, of the United States Department of Agriculture, through whose interest

it was possible for me to prosecute field work in Kwangtung Province. Mr. Tutcher informs me that the same form is represented in the Hongkong herbarium, from Chaochaufu, collected by Mr. Dunn.

EURYA GLANDULOSA sp. nov.

Arbor 4 ad 5 m alta, ramis crassis, glabris, ramulis junioribus plus minusve adpresse villosis glabrescentibus; foliis oblongis, brevissime petiolatis, coriaceis, flavido-viridis, 4 ad 5 cm longis, 1.5 ad 2 cm latis, basi distincte cordatis, aequilateralibus vel subaequilateralibus, apice acutis vel breviter acuminatis, margine glanduloso-crenulatis, utrinque glabris, nitidis, subtus prominente glandulosis; nervis lateralibus utrinque circiter 10, subtus prominentibus, arcuato-anastomosantibus, reticulis laxis, supra impressis, obscuris; floribus ♀ axillaribus, solitariis binis vel trinis, subsessilibus vel brevissime pedicellatis, albidis; sepalis orbiculari-ovatis, obtusis, 2 mm longis, coriaceis, extus leviter adpresse subferrugineo-pubescentibus, margine prominente brunneo-glandulosis; petalis 5, glabris, anguste oblongo-obovatis, obtusis vel leviter retusis, circiter 4 mm longis et 2 mm latis, infra distincte connatis; ovarium ovoideum, glabrum; stylis 3, circiter 1.5 mm longis ima in stylum 0.5 ad 1 mm longum cylindricum glabrum connatis.

Loh Fau Mountain (Lofaushan), *Merrill 10379*, October 28, 1916, in damp shaded ravines, altitude about 1,000 meters.

A species well characterized by its distinctly cordate, nearly equilateral leaves, which are prominently glandular on the margins and on the lower surface, and its glandular sepals. Its alliance is apparently with *Eurya amplexifolia* Dunn. and *E. obliqua* Hemsl., differing from the former in its shortly petioled, not amplexicaul leaves, and from the latter in its nearly equilateral leaves.

SYMPLOCACEAE

SYMPLOCOS Jacquin

SYMPLOCOS GROFFII sp. nov. § *Bobua, Lohdra.*

Arbor parva, 3 ad 4 m alta, ramulis petiolisque et foliis supra ad costa et subtus ad costa nervisque prominente villosis; foliis breviter petiolatis, chartaceis, nitidis, oblongis, 6 ad 10 cm longis, 1.5 ad 2.8 cm latis, apice tenuiter acute acuminatis, margine argute serrulatis ad subintegris, basi acutis, nervis utrinque 7 ad 10, tenuibus, anastomosantibus; floribus axillaribus, fasciculatis, confertis, sessilibus vel brevissime pedicellatis, albidis; bracteis ovatis, acutis, 1.5 ad 2 mm longis, ciliato-hirsutis; calycibus lobis ovatis, rotundatis, 1 mm longis, pubescentibus; staminibus circiter 50, filamentis infra plus minusve connatis et cum petalis adnatis, glabris; petalis elliptico-oblongis, rotundatis,

5.5 ad 6 mm longis, liberis vel infra leviter connatis; ovarium pubescens, 3-loculare.

Loh Fau Mountain (Lofaushan), *Merrill 10257*, October 28, 1916, in damp shaded ravines, altitude about 1,100 meters.

A very characteristic species manifestly in the alliance with *Symplocos adenopus* Hance and *S. glandulifera* Brand. It is well characterized by its axillary, fascicled, crowded flowers, its very densely villous branchlets, and its villous leaves. From *Symplocos adenopus* Hance, the type of which was from Loh Fau Mountain, it is distinguished, among other characters, by its villous leaves, its shorter, densely villous, not glandular petioles, and pubescent ovaries, and from *Symplocos glandulifera* Brand by its smaller villous leaves which are slenderly and sharply acuminate, their margins often sharply serrulate but not glandular, densely villous, shorter petioles and branchlets, and other characters. This new species is dedicated to Mr. G. W. Groff, of the Canton Christian College, to whom I am indebted for the opportunity of visiting Loh Fau Mountain, and for numerous courtesies extended during my field work in Kwangtung Province.

VERBENACEAE

CALLICARPA Linnaeus

CALLICARPA LONGISSIMA (Hemsl.) comb. nov.

Callicarpa longifolia Lam. var. ? *longissima* Hemsl. in Journ. Linn. Soc. Bot. 26 (1890) 253.

Honam Island, near Canton, *Merrill 9986*, in villages near Canton Christian College.

The type of Hemsley's variety was from near Canton, and is the form interpreted by Hance and by Maximowicz as *Callicarpa longifolia* Lam. Lamarck's type was from Malacca, and *Callicarpa longifolia* Lam. is a species entirely distinct from this Chinese form; Hemsley states that his var. *longissima* stands out very distinctly from all others (i. e., other forms of *Callicarpa longifolia* Lam.) and perhaps should be raised to specific rank. It is distinguished from Lamarck's species by its narrow, elongated, nearly glabrous, entire or but very minutely toothed leaves, its smaller flowers, and other characters. In some respects it approaches the Philippine *Callicarpa dolichophylla* Merr., from which it is distinguished by its vegetative characters.

VITEX Linnaeus

VITEX QUINATA (Lour.) F. N. Williams in Bull. Herb. Boiss. II 5 (1905) 431.

Cornutia quinata Lour. Fl. Cochinch. (1790) 387.

Vitex loureirii Hook. & Arn. Bot. Beechy's Voy. (1841) 206, *t. 48*.

Honam Island, near Canton, *Merrill 9996*, about villages, November 3, 1916, a tree 10 to 12 meters high.

The type of *Cornutia quinata* Lour. was from Canton. It is by no means certain that Hemsley was correct in reducing *Vitex loureirii* Hook. & Arn. to *V. heterophylla* Wall., for the Chinese specimens are distinctly different from the Indian ones currently referred to Roxburgh's species. Whatever the relative status of the two species may be, Loureiro's specific name is much the older.

SCROPHULARIACEAE

ALECTRA Thunberg

ALECTRA ARVENSIS (Benth.) comb. nov.

Glossostylis arvensis Benth. Scroph. Ind. (1835) 49.

Hymenospermum dentatum Benth. in Wall. Cat. (1831) no. 3963, *nomen nudum.*

Alectra indica Benth. in DC. Prodr. 10 (1856) 339.

Alectra dentata O. Kuntze Rev. Gen. Pl. (1891) 458.

Loh Fau Mountain (Lofaushan), *Merrill s. n.*, October 28, 1916, scattered on open grassy slopes, altitude 900 to 1,000 meters.

India to Burma, southern China, northern Luzon, and Mauritius.

The oldest valid specific name is here adopted for this species; *Hymenospermum dentatum* Benth. is a *nomen nudum.*

ADENOSMA R. Brown

ADENOSMA GLUTINOSUM (Linn.) comb. nov.

Gerardia glutinosa Linn. Sp. Pl. (1753) 611; Osbeck Dagbok Ostind. Resa (1757) *t. 9.*

Digitalis sinensis Lour. Fl. Cochinch. (1790) 378.

Pterostigma grandiflorum Benth. in DC. Prodr. 10 (1846) 380.

Pterostigma rubiginosum Walp. in Nov. Act. Acad. Nat. Cur. 19 (1843) Suppl. 1: 393.

Adenosma grandiflorum Benth. ex Hance in Jorun. Linn. Soc. Bot. 13 (1874) 114.

Macao, *Callery 314*, 1844.

The oldest specific name is here adopted for this well-known species, which is represented by several collections from southern China. The Linnean type was apparently a specimen collected in Kwangtung Province by Osbeck.

ACANTHACEAE

HEMIADELPHIS Nees

HEMIADELPHIS POLYSPERMA (Roxb.) Nees in Wall. Pl. As. Rar. 3 (1832) 80.

Justicia polysperma Roxb. Fl. Ind. 1 (1820) 120.

Ruellia polysperma Roth Nov. Pl. Sp. (1821) 305.

Adenosma polysperma Spreng. Syst. 2 (1825) 829.

Hygrophila polysperma T. Anders. in Journ. Linn. Soc. Bot. 9 (1867) 456.

Honam Island, near Canton, *Merrill 10024, 10078*, October 25 and November 6, 1916, in muddy places near the river and about water holes at low altitudes.

This species is widely distributed in British India, extending to Malacca and Tonkin, but has not been previously reported from China. It appears in current literature as *Hygrophila polysperma* T. Anders., but there is no valid reason for this disposition of it, as it differs from the typical representatives of *Hygrophila* in so many characters. As a genus *Hemidelphis* is much more prominently characterized than are numerous other universally recognized genera of the *Acanthaceae.* From *Hygrophila* it is at once distinguished by its habit, its terminal, spicate, prominently brac-

teate inflorescenses, and the presence of but two stamens. In Indian material the other two stamens are reduced to staminodes, which Clarke indicates as "sometimes nearly obsolete." In the Chinese specimens the staminodes are entirely obsolete.

HYGROPHILA R. Brown

HYGROPHILA MEGALANTHA sp. nov.

Herbacea, erecta, ramosa, glabra, ramis 4-angulatis, haud lineolatis; foliis anguste oblongo-obovatis ad oblanceolatis, apice obtusis vel rotundatis, basi attenuatis, integris, obscure lineolatis, 4 ad 7 cm longis, 8 ad 15 mm latis, nervis utrique 5 vel 6, adscendentibus, obscuris; floribus paucis, in quaque axilla 1 ad 3, bracteis oblongo-lanceolatis, obtusis, 12 mm longis, bracteolis anguste oblongis, obtusis, 6 mm longis; calycibus tubo circiter 7 mm longo, laciniis anguste lineari-lanceolatis, tenuiter subcaudato-acuminatis, parcissime breviter hirsutis, tubo aequantibus; corolla 2.5 cm longa, extus parcissime breviter hirsuta, tubo infra cylindrico, supra inflato; labium superium retusum, inferius breviter 3-lobatum.

Honam Island, near Canton, *Merrill 10014*, October 26, 1916, in muddy fallow land subject to overflow by the tide, the flowers purplish-blue.

A species well characterized by its very few, unusually large flowers, and its oblong-obovate to oblanceolate, glabrous leaves. Its alliance seems to be with the form described by Nees as *Hygrophila obovata*, which Clarke has reduced to *Hygrophila quadrivalvis* Nees. It cannot possibly be referred to any form of *Hygrophila salicifolia* (Vahl) Nees (*H. angustifolia* R. Br.), or *H. quadrivalvis* Nees as these species are described.

COMPOSITAE

AINSLIAEA de Candolle

AINSLIAEA PARVIFOLIA sp. nov. § *Scaposae.*

Herba erecta, caulis infra foliis plus minusve lanuginosis, supra foliis glabris, foliis junioribus subtus parce lanuginosis; foliis rosulatis, longe petiolatis, ovatis ad oblongo-ovatis, subcoriaceis, 2.5 ad 4 cm longis, 1.2 ad 2 cm latis, supra glabris, apice acutis apiculatisque, basi cuneatis, leviter decurrentibus, margine obscure crenulatis in sinibus dentibus prominentibus calloso-apiculatis circiter 1 mm longis ornatis, nervis utrinque 2 vel 3, distantibus, prominentibus, curvato-adscendentibus, anastomosantibus, in siccitate brunneis; petiolis 3 ad 4 mm longis, glabris, vel parce lanuginosis, sursum angustissime alatis; inflorescentiis simplicibus, glabris, racemosis; capitulis breviter pedicellatis, numerosis, patulis vel adscendentibus, solitariis, circiter 15 mm longis, 3-floris, pedicellis usque ad 3 mm longis bracteis numerosis ovatis obtusis imbricatis 0.5 ad 1 mm longis obtectis; squamulis valde inaequalibus, omnibus glabris, exterio-

ribus ovatis, obtusis, circiter 1 mm longis, interioribus lineari-lanceolatis, acutis, 10 mm longis, pappum aequantibus; corolla circiter 12 mm longa, lobis linearibus, obtusis, 7 mm longis; acheniis circiter 2 mm longis adpresse subferrugineo-pubescentibus.

Loh Fau Mountain (Lofaushan), *Merrill 10237*, October 28, 1916, widely scattered on open grassy slopes, altitude 500 to 1,100 meters, the flowers white, the involucre bracts dull purple.

Beauverd,[9] in his treatment of the genus *Ainsliaea*, recognizes thirty-three species, which he distributes into three sections, *Scaposae*, *Aggregatae*, and *Frondosae*. The present species I have placed in the section *Scaposae*, as the leaves are crowded in a dense rosette, which is sometimes at the surface of the ground, at other times as much as 8 cm above the base of the plant. It appears to be allied to *Ainsliaea henryi* Diels, but differs in numerous characters, such as its long petioled, smaller, differently shaped leaves, and its much larger heads. I have not seen the description of *Ainsliaea walkeri* Hook. f., of the section *Aggregatae*, which was based on specimens cultivated at Kew derived from seeds secured by Walker in Hongkong, but this form is keyed out by Dunn and Tutcher[10] as having *linear* leaves, a character that does not at all apply to the present species.

COMPOSITAE

WEDELIA Jacquin

WEDELIA CHINENSIS (Osbeck) comb. nov.

Solidago chinensis Osbeck Dagbok Ostind. Resa (1757) 241.
Verbesina calendulacea Linn. Sp. Pl. (1753) 902.
Wedelia calendulacea Less. Syn. Compos. (1832) 222, non Pers. (1807).

Honam Island, near Canton, *Merrill 10123*, October 25, 1914, common and widely distributed on paddy banks, dry open slopes, etc.

In my consideration of the Kwangtung species described by Osbeck[11] I was unable to dispose of *Solidago chinensis* Osbeck; but now, after considerable field work in the region that Osbeck explored, I feel confident that the plant he named and very briefly described must be the form commonly known as *Wedelia calendulacea* Less. It is exceedingly common at low altitudes in Kwangtung Province, especially near the river. *Solidago virgaurea* Linn. (*S. cantoniensis* Lour.) is common on Loh Fau Mountain, extending from near its base to the summit, and I also discovered it on Honam Island, growing on open sterile slopes at an altitude of not more than 15 meters, but Osbeck's description does not at all apply to *Solidago virgaurea* Linn. *Wedelia calendulacea* Less. is untenable for this species, as the name is preoccupied by the Mexican *Wedelia calendulacea* Pers., this apparently being the earliest valid name for the plant commonly known as *Wedelia hispida* HBK. Among all the *Compositae* collected by me in Kwangtung Province, this species is the only one that conforms at all with Osbeck's description.

[9] Bull. Soc. Bot. Genève II 1 (1909) 376–385.
[10] Fl. Kwangtung and Hongkong. *Kew Bull. Add. Series* 10 (1912) 149.
[11] Am. Journ. Bot. 3 (1916) 585.

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THE DATES OF PUBLICATION OF THE THIRD EDITION OF BLANCO'S "FLORA DE FILIPINAS"

By E. D. MERRILL[1]

(From the Botanical Section of the Biological Laboratory, Bureau of Science, Manila, P. I.)

The third edition of Blanco's "Flora de Filipinas" was prepared by Father Celestino Fernandez-Villar and Father Andrés Naves, of the Augustinian Order, more than thirty years after Blanco's death. It was printed in Manila during the years 1877 to 1883, under the general editorship of Domingo Vidal y Soler, who supervised the printing of the first two volumes; the remaining volumes were printed after he had left Manila, and his place was apparently taken by his brother, Sebastian Vidal y Soler.

The first three volumes of this edition consist only of a reprint of the second edition of Blanco's work, with the addition of a Latin translation of the same. No new matter was added, so that the exact date of publication of these volumes is of little special value. Volume IV, however, contains the "Novissima Appendix" by Villar and Naves, the title page giving the date of publication as 1880, while on page 373, the printer's date for the last fascicle is given as June 15, 1883. As this is really the most important part of the third edition, and contains a number of new combinations, as well as the descriptions of some new species, the actual date of publication of the various parts is of considerable importance. In some cases the same name transfers were made by other botanists in the intervening three years, and it has previously been difficult or impossible definitely to determine which author should be credited with the transfer according to the rules of priority.

The work was issued in fascicles, and I have previously made several attempts to ascertain the dates of publication of the various parts, especially of the "Novissima Appendix," but without success. Even Father Fernandez-Villar was unable to give me any definite information as to this portion of the work, other than that a number of parts were issued in 1880, and that there was considerable delay in printing the remaining ones. Fortu-

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nately I have been able to examine a complete unbound copy of the work, in the original fascicle-covers, the property of D. Juan Javier, of Manila, and have been able definitely to determine the years in which the different fascicles were issued, according to the dates printed on the backs of the fascicle covers.

From the prospectus issued in 1877 it is learned that the plan of publication was to issue at least two and not to exceed three fascicles each month, each fascicle to consist of 16 pages of text with 6 plates. Two editions were advertised, the edition de luxe, printed on a special quality of paper accompanied by colored plates, and a cheaper edition, on poorer quality of paper, and with uncolored plates. The price per fascicle for the edition de luxe in the Philippines was fixed at \$2.25, outside the Philippines \$2.50, and for the cheaper edition \$1.25, and \$1.75 respectively; the prices were local currency (Mexican silver).

The edition de luxe was to be limited to 500 copies, which were to be numbered and each was to be inscribed with the name of the subscriber. The latter part of this plan, at least, does not seem to have been adhered to, as I have seen no numbered copies of this work among about 15 examples examined.

Volume I consists of 24 fascicles, none of which are dated. The date given on the title page of the volume is 1877, which is doubtless correct, as the prospectus was issued the same year, while Volume II appeared, in part, the following year.

Volume II consists of 27 fascicles, but of these 9 are double, that is, 2 fascicles are contained in a single cover; these double fascicles were 3-4, 6-7, 9-10, 12-13, 15-16, 18-19, 21-22, 24-25, and 26-27. Fascicles 1 to 19, consisting of pages 1 to 304, are dated on the fourth page of the covers 1878, the date given on the title page of the volume; fascicles 20 to 28, consisting of pages 305 to 419, and index, are dated 1879.

Volume III consists of 7 fascicles, of which 4 are double like those of Volume II; the double ones are 2-3, 5-6, 8-9, and 14-15. All the fascicles of this volume are dated 1879, the date given on the title page of the volume.

Volume IV consists of 24 fascicles, numbered from 1A to 23A, the last being unnumbered and indicated as "entrega ultima." Two of these are double, 4-5, and 9-10. Fascicles 1A to 12A are all dated 1880, and contain the articles by Llanos and Mercado, up to and including page 58 of Mercado's paper; fascicles 13A to the end comprise the "Novissima Appendix;" No. 13A contains also the last page of Mercado's paper and the index to the same. The dates of publication of these parts are of con-

siderable importance and are given below. No months are given, being unknown, except for the last 18 pages.

13A to 21A, Novissima Appendix, pages 1 to 272 (1880).
22A to 23A, Novissima Appendix, pages 273 to 336 (1882).
[24A] "Entrega ultima," Novissima Appendix, pages 337 to 375 (June 15, 1883).

The dates given are those printed on the fourth page of each fascicle-cover, and are probably correct. In this connection it is well to note that the introduction to the "Novissima Appendix," page IX, is dated December 12, 1880. It is possible that this was printed at a later date than were the other fascicles, otherwise it is difficult to conceive how 272 pages of this large work could be printed and distributed between December 12 and the close of the year. It is, of course, possible that the dates on the fascicle-covers are wrong, but in any event those credited to the year 1880 could scarcely have been later than 1881. If the dates given on the fascicle-covers are correct, and I know of no method of disproving them, it will be noted that no part was issued in the year 1881, and that but three parts were issued in the years 1882–1883, which corresponds with information supplied by F.-Villar in the year 1902, to the effect that a number of parts were issued in 1880, but that after that date considerable delay ensued in finishing the work.

As noted above, the edition de luxe of this work was limited to 500 copies. By no means this number is now extant, as at least a portion of the unsold ones was destroyed by fire in the burning of the Guadalupe convent, near Manila, February 19, 1899. In a letter written by Father Fernandez-Villar in the year 1902, in response to a request made by me, he informed me that many bound volumes of the work, about 4,000 unbound parts, and 16,000 plates were destroyed in the Guadalupe fire; the above figures may in part apply to the cheaper edition with the uncolored plates.

Copies of this work are not uncommon in Manila, but all that I have had the privilege of examining, here or elsewhere, with the exception of the one copy from which the above data regarding the dates of issue were taken, have been bound, and the original fascicle-covers not preserved.

Most copies of the work have the plates segregated in two volumes, but one of the copies in the library of the Bureau of Science has them scattered through the text of the four volumes. With the hope that this copy of the work might throw some light on the dates of issue of the plates, it was carefully ex-

amined. The sequence of the plates, as numbered by F.-Villar, was found only in part to approximate the sequence of issue of the fascicles as indicated by the arrangement of the plates in the above copy.

The single imperfect copy of the cheaper edition that I have seen differs from the edition de luxe in that the figures are not colored, and that each plate is numbered, while both the text and the plates are printed on cheaper paper than is the edition de luxe. The numbers assigned to the plates in the edition de luxe can be determined only by reference to the text, or to the list of plates at the end of the "Novissima Appendix" or sometimes placed with the first volume of plates. The highest number given is *plate 468*, but none were issued corresponding to the numbers *2, 16, 61, 65, 77, 92, 101, 103, 107, 123, 169, 186, 325*, and *342*, while on the other hand two different plates were assigned to the following numbers: *43, 73, 86, 94, 100, 124, 131, 138, 167, 175, 210, 226, 257, 261, 368, 382, 402, 404, 405, 414, 415, 425, 426, 427, 428, 429*, and *442*, so that in reality complete sets of the work should contain 473 plates representing plants. However, one plate which was numbered, that is *67, Cyperus paniculatus*, does not appear to have been issued, as it is missing in all the sets I have examined, except one, which has a handmade copy of the plate in question.

In connection with the above data regarding the dates of issue of this work it is well, perhaps, again to record the fact that F.-Villar was the author of the "Novissima Appendix" from page 1 to 212, and from *Fimbristylis subbispicata* on page 307 to the end of the volume; while Naves was the author of page 213 to *Fimbristylis nutans* on page 307 and was responsible for the names on the plates for the entire work.

Father Celestino Fernandez-Villar was born in Tudela, Oviedo, Spain, April 3, 1838, and died in Manila on April 28, 1907. An account of his life and work has been given by Father P. M. Vélez, under the title "Un misionero ilustre en la Ciencia, el P. Celestino Fernandez-Villar" in the periodical entitled "España y America" **5** (1907), no. 14, and **6** (1907-08) nos. 1, 9, and 10.

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